

In cooperation with the Mississippi Department of Environmental Quality, information regarding the Water-Supply Scenarios is preliminary and is subject to revision. It is being provided to meet the need for timely best science. The information is provided on the condition that neither the U.S. Geological Survey nor the U.S. Government may be held liable for any damages resulting from the authorized or unauthorized use of the information.

A Stakeholder driven approach to optimize modeling and monitoring of water resources in the Mississippi Alluvial Plain

November 29, 2018

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USGS, Lower Mississippi-Gulf Water Science Center

Mississippi Alluvial Plain - MAP

MAP Start FY16
Project Duration: FY17 – FY21
Monitoring and Modeling

USGS
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Mississippi Alluvial Plain (MAP) Regional Water Availability Study

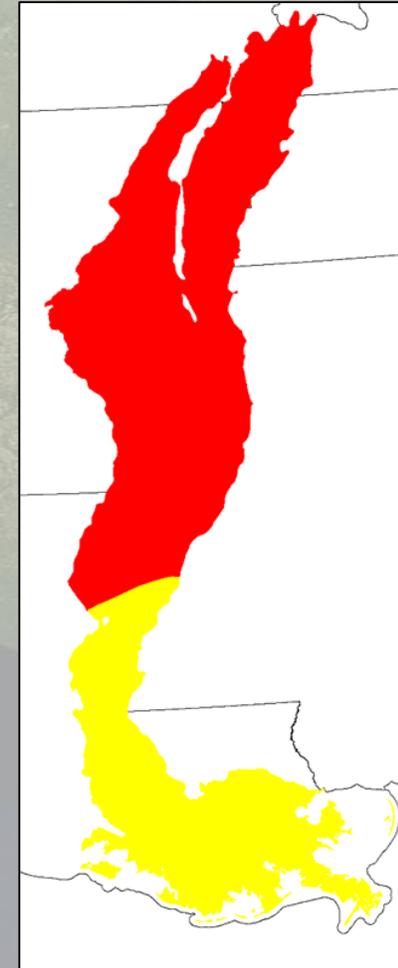
Home News*new Status Water Budget Geophysics Support System Products Partners Staff Study Area Maps*new

The **Mississippi Alluvial Plain (MAP)** has become one of the most important agricultural regions in the US, and it relies heavily on a groundwater system that is poorly understood and shows signs of substantial change. The heavy use of the available groundwater resources has resulted in significant groundwater-level declines and reductions in base flow in streams within the MAP. These impacts are limiting well production and threatening future water-availability for the region. Over 9 billion gallons per day of groundwater are withdrawn for irrigation, supporting agricultural production. Agricultural interests in the region are aware to the economic and environmental costs that may come from declining water supplies but lack the basic resource description and analytical tools necessary for effective decision making at a regional scale. Technical specialists working in various Federal and State agencies and universities have worked individually and in partnership over many years to address aspects of particular water issues in the MAP, but no single agency or group has had the resources to support a broad-based and comprehensive scientific effort.

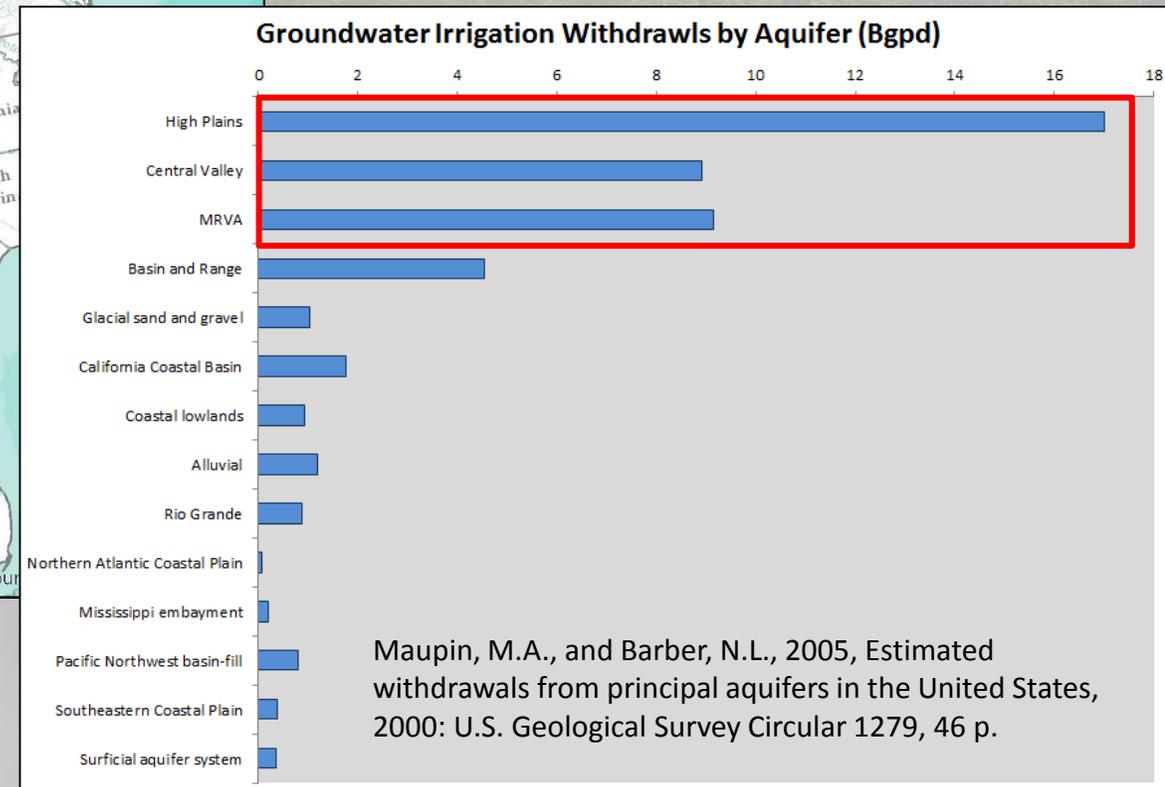
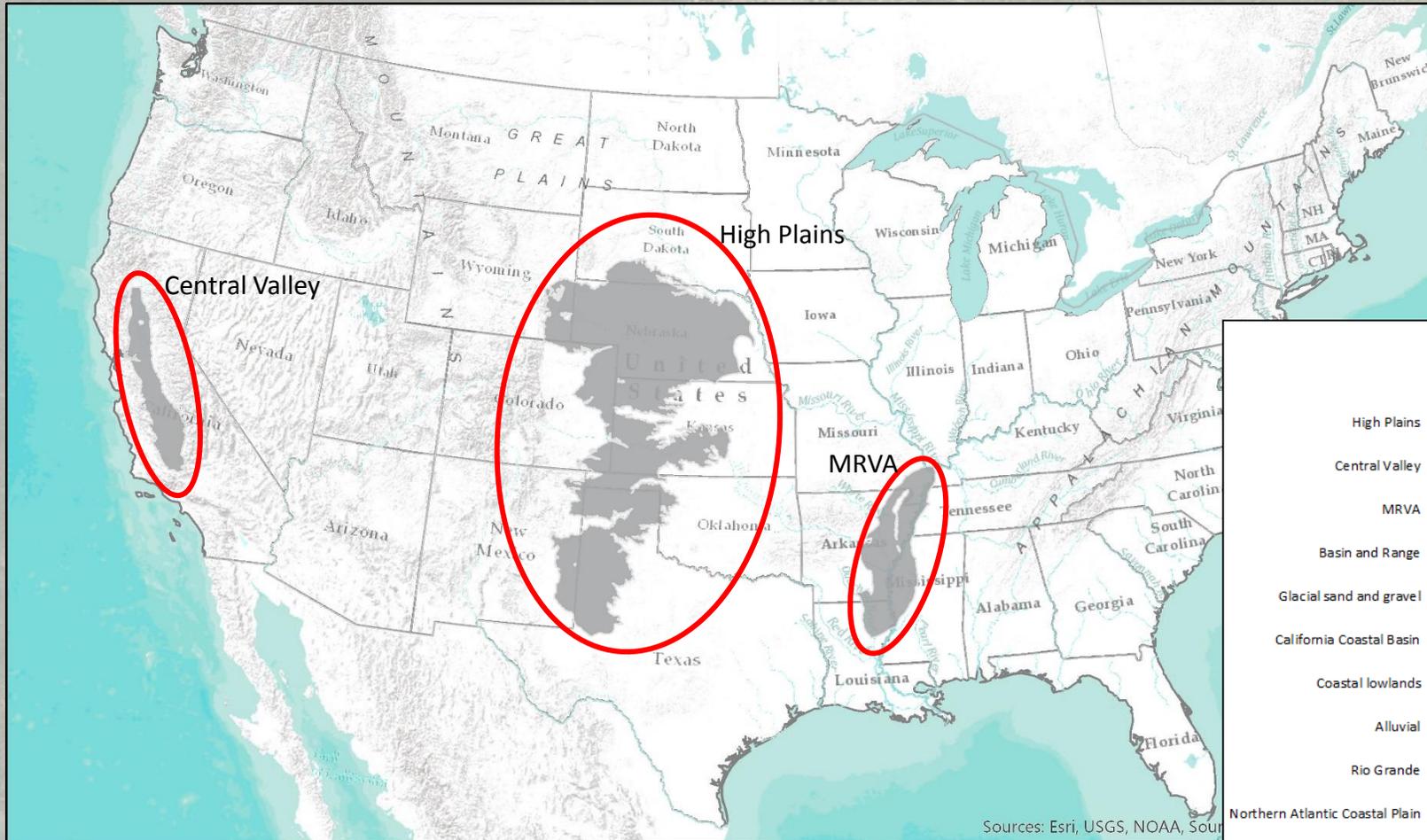
Accurate and ongoing assessments of water availability in the MAP region are critically important for making well-informed management decisions about resource allocation and sustainability, establishing best practices for water use, and dealing with predicted additional changes to the regional water cycle over the next 50-100 years. The goal of the MAP water use and availability project is to improve estimates of water availability for the present, past, and future in the MAP region, to aid water resource managers in making decisions that can help to sustain key agricultural and industrial practices

The U.S. Geological Survey (USGS) [Water Availability and Use Science Program \(WAUSP\)](#) is supporting a regional groundwater availability study of the Mississippi Alluvial Plain (MAP) to provide stakeholders and managers information and tools to better understand and manage groundwater

The Mississippi Alluvial Plain

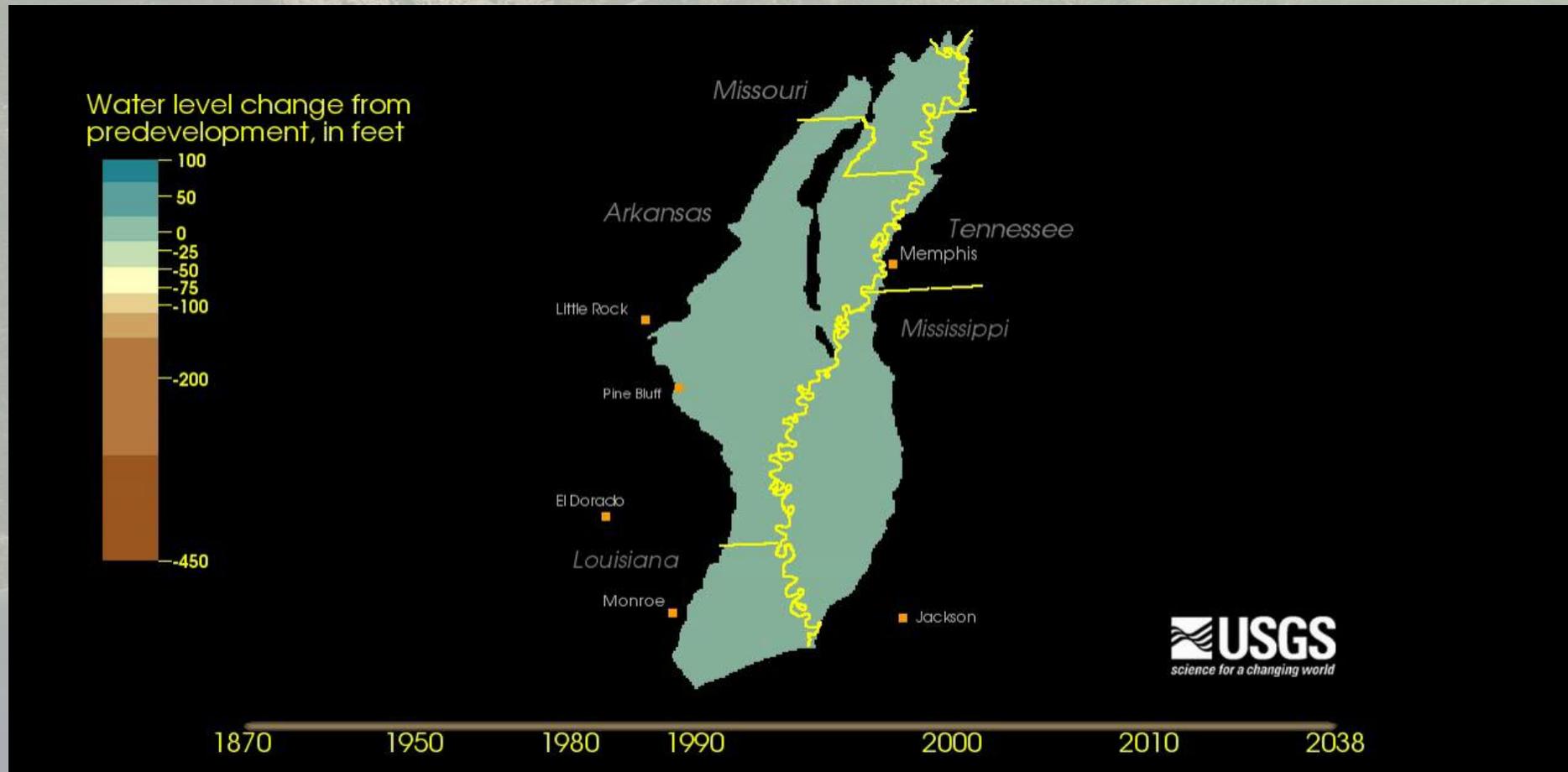


Principal Aquifers – Water Use

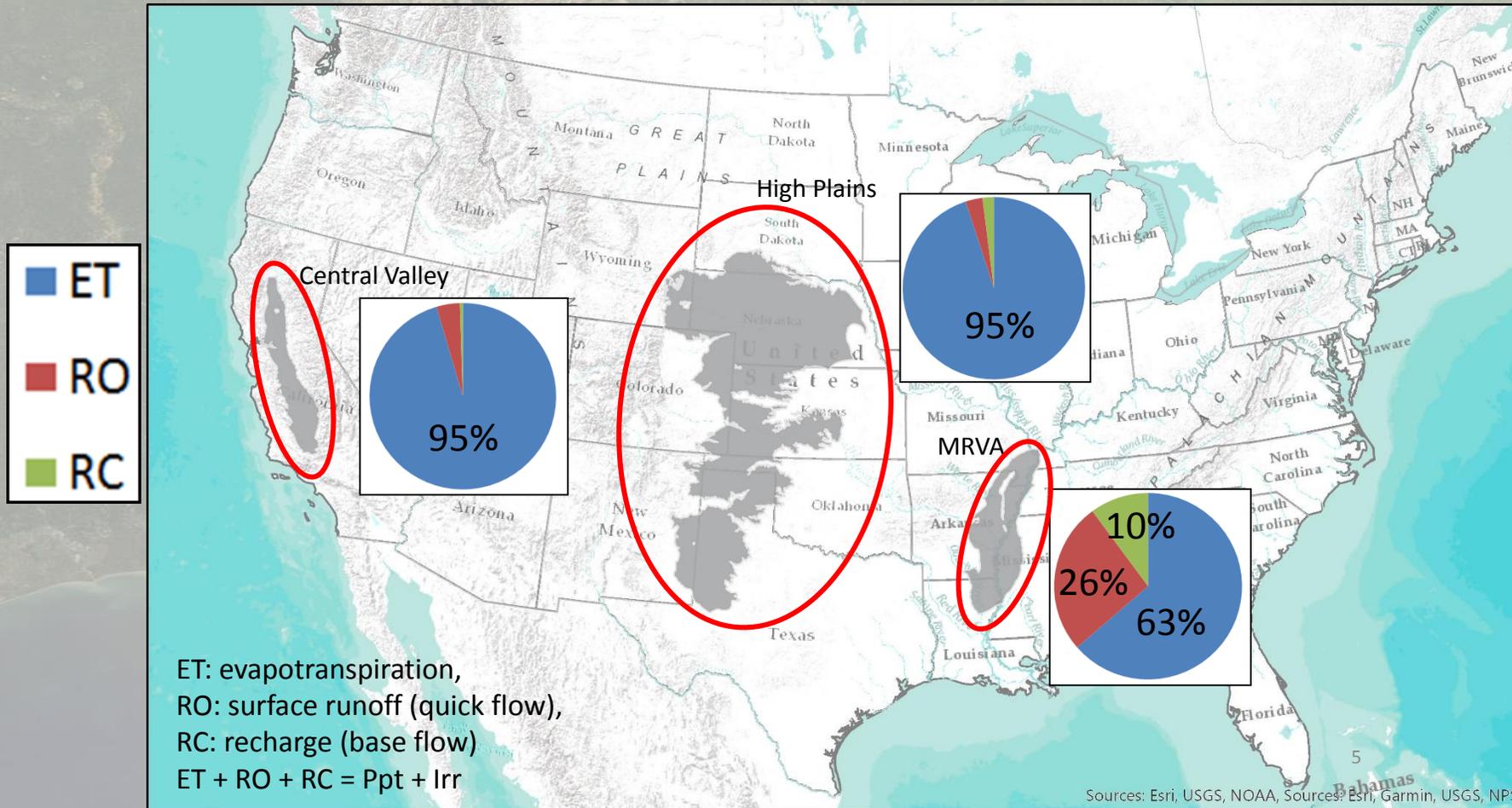


Maupin, M.A., and Barber, N.L., 2005, Estimated withdrawals from principal aquifers in the United States, 2000: U.S. Geological Survey Circular 1279, 46 p.

GW Level Declines



Principal Aquifers – Water Budget



MAP Team

USGS
 3 Mission Areas
 13 Centers/Branches
 ~60 People
 ~20 FTE
 3 Contractors

Watermark Numerical
 Computing

HydroGeophysics Group
 AARHUS UNIVERSITY

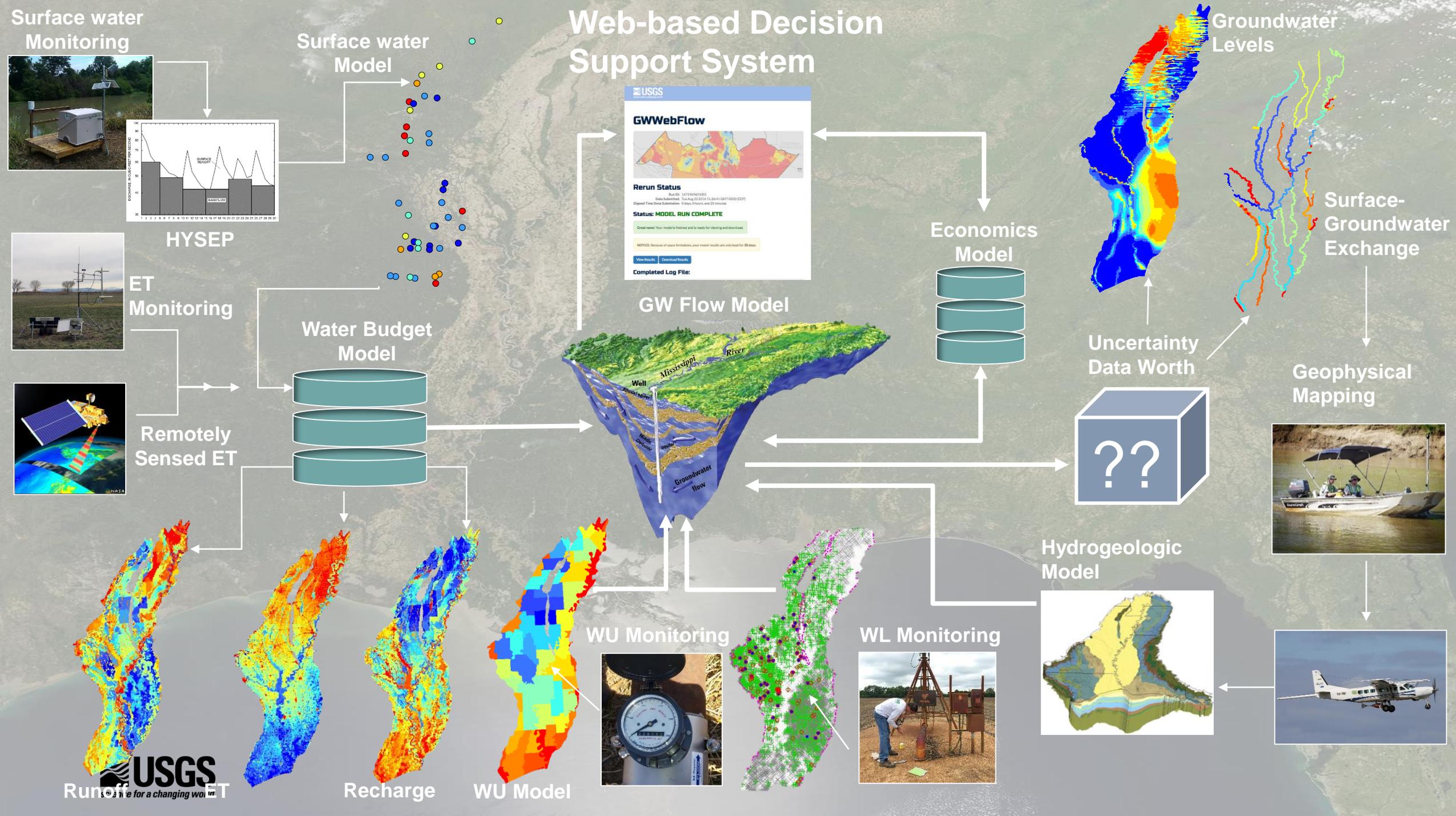


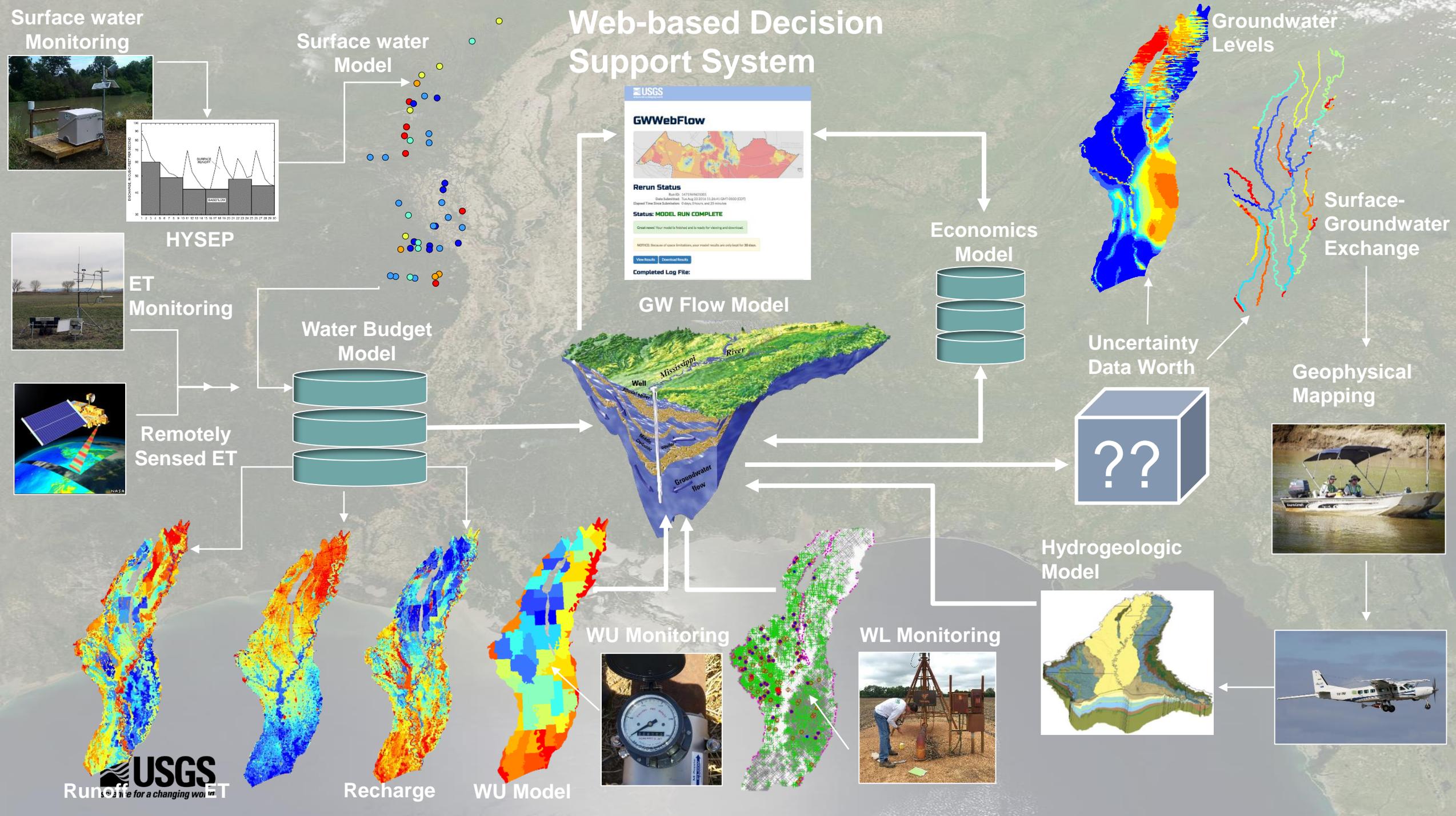
Fisher Delta
 Research Center
 University of Missouri



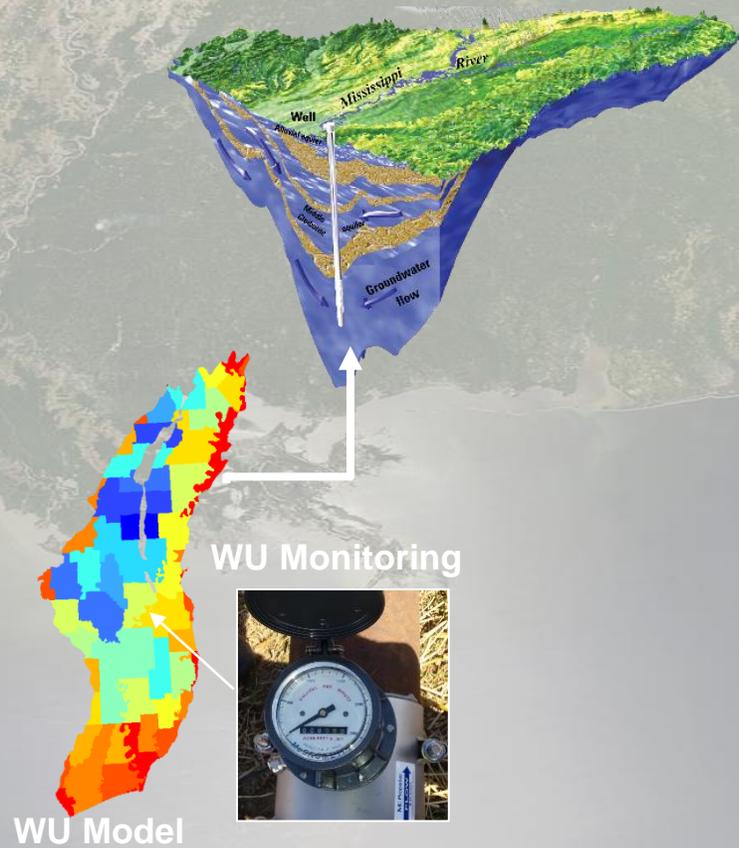
Sources: Esri, USGS, NOAA, Sources: Esri, Garmin, USGS, NPS





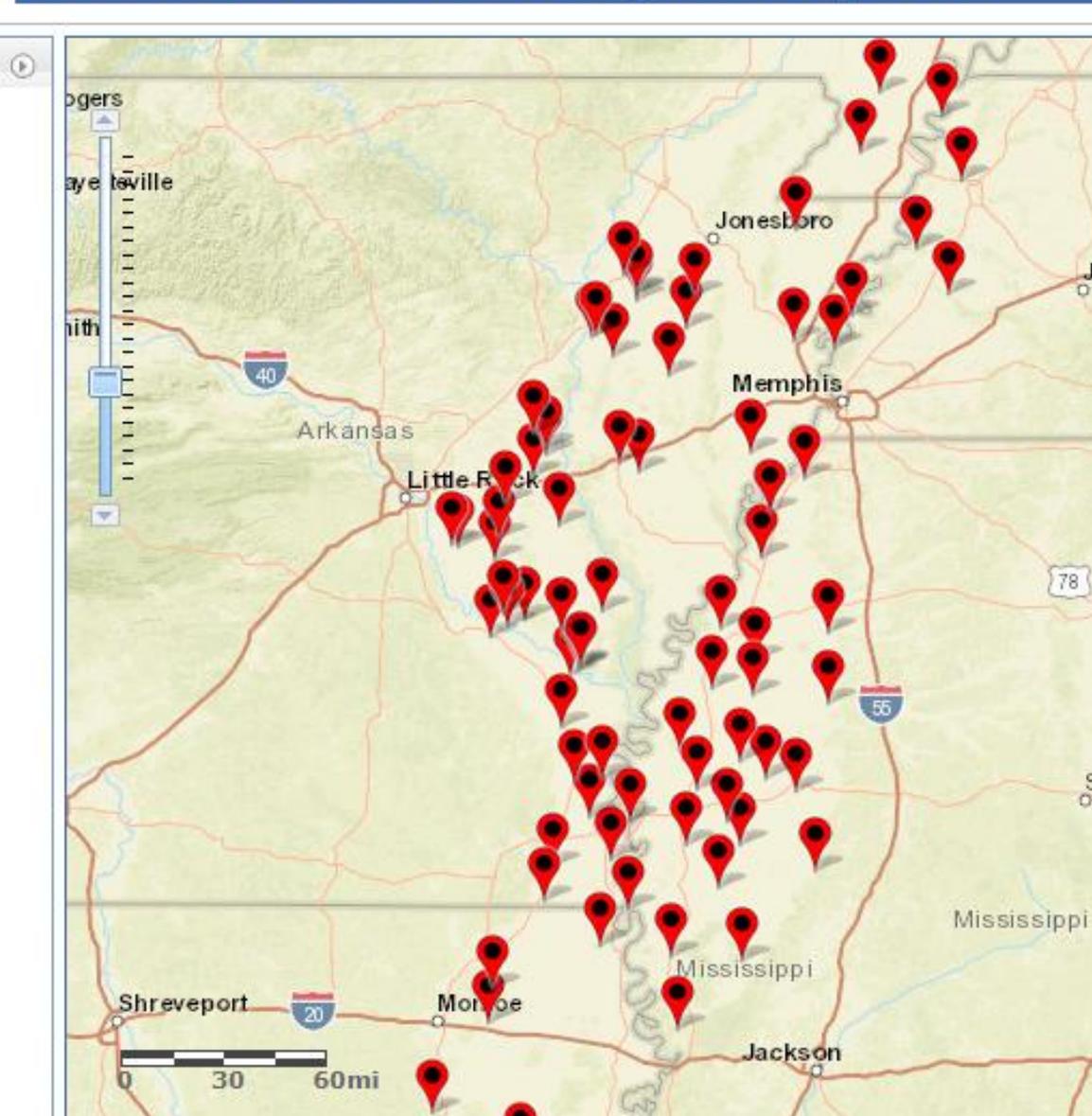


Water Use Monitoring and Mapping Efforts





National Water Information System: Map View



Real-time Water-Use Monitoring

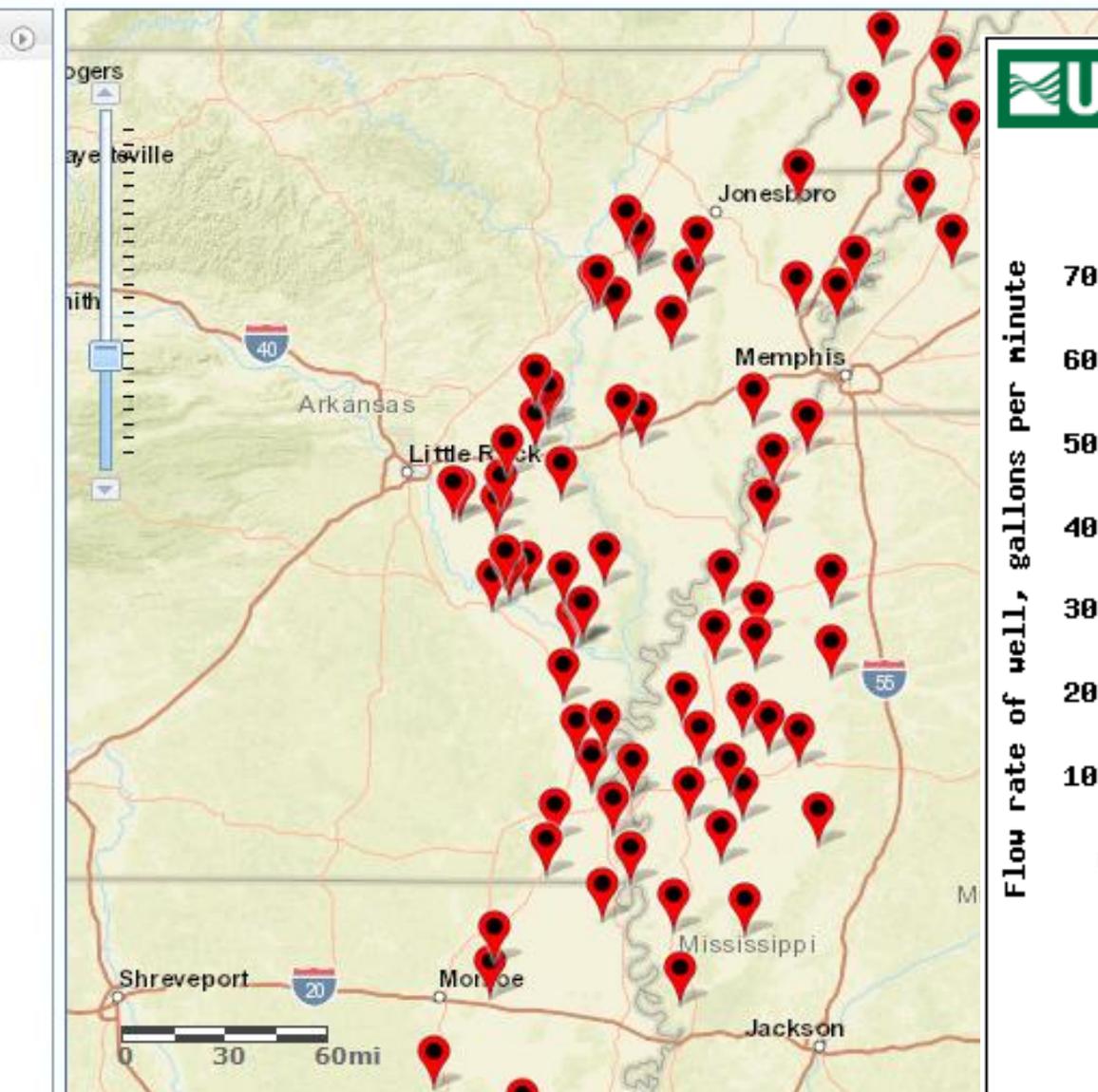
5 Sites in Louisiana in operation since May of 2018



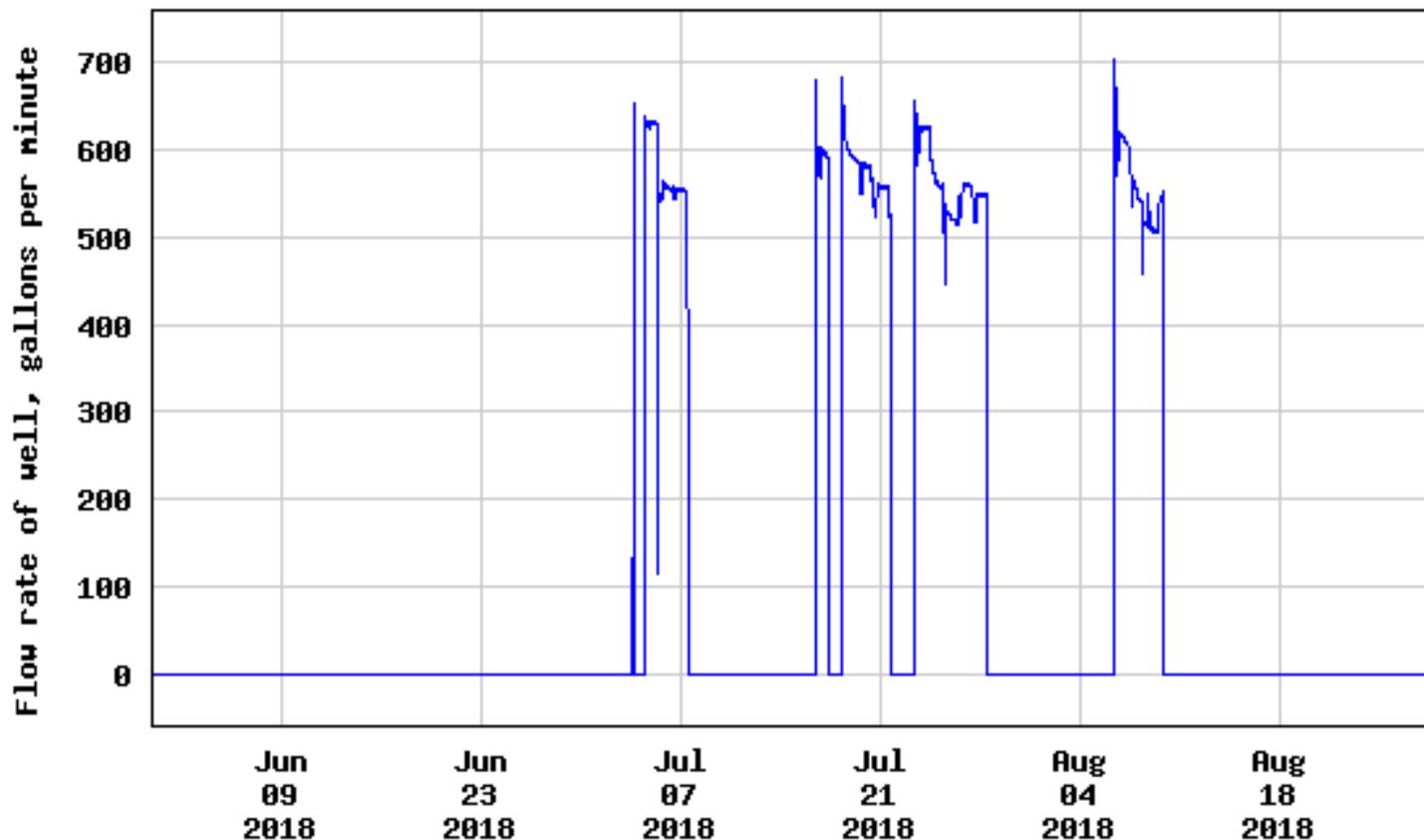
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National Water Information System: Map View

Real-time Water-Use Monitoring

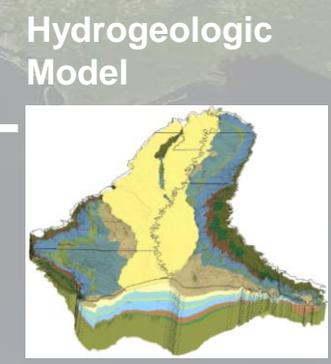
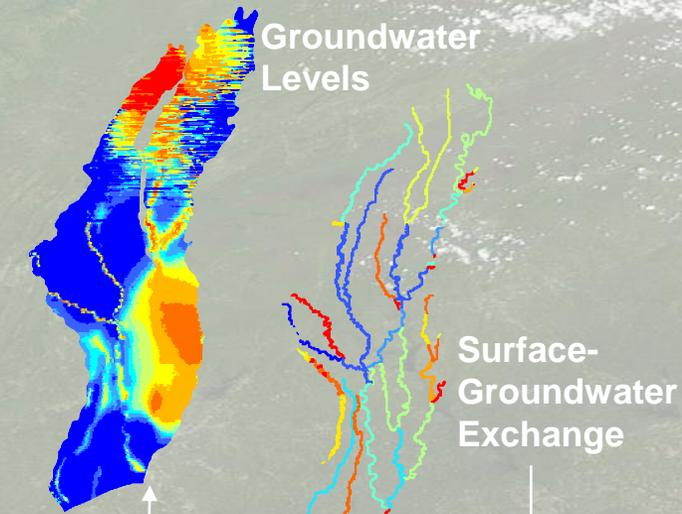
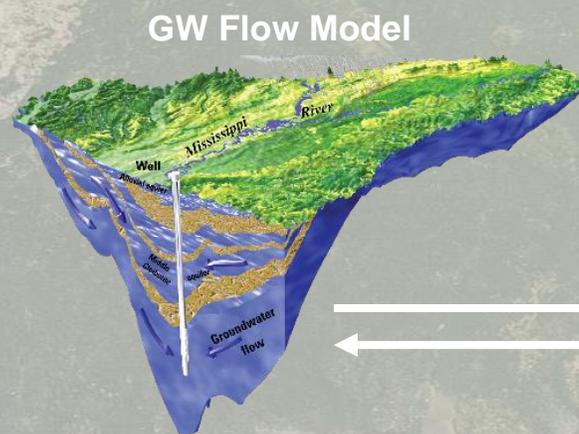


USGS 321327092062101 Ca-196 WU

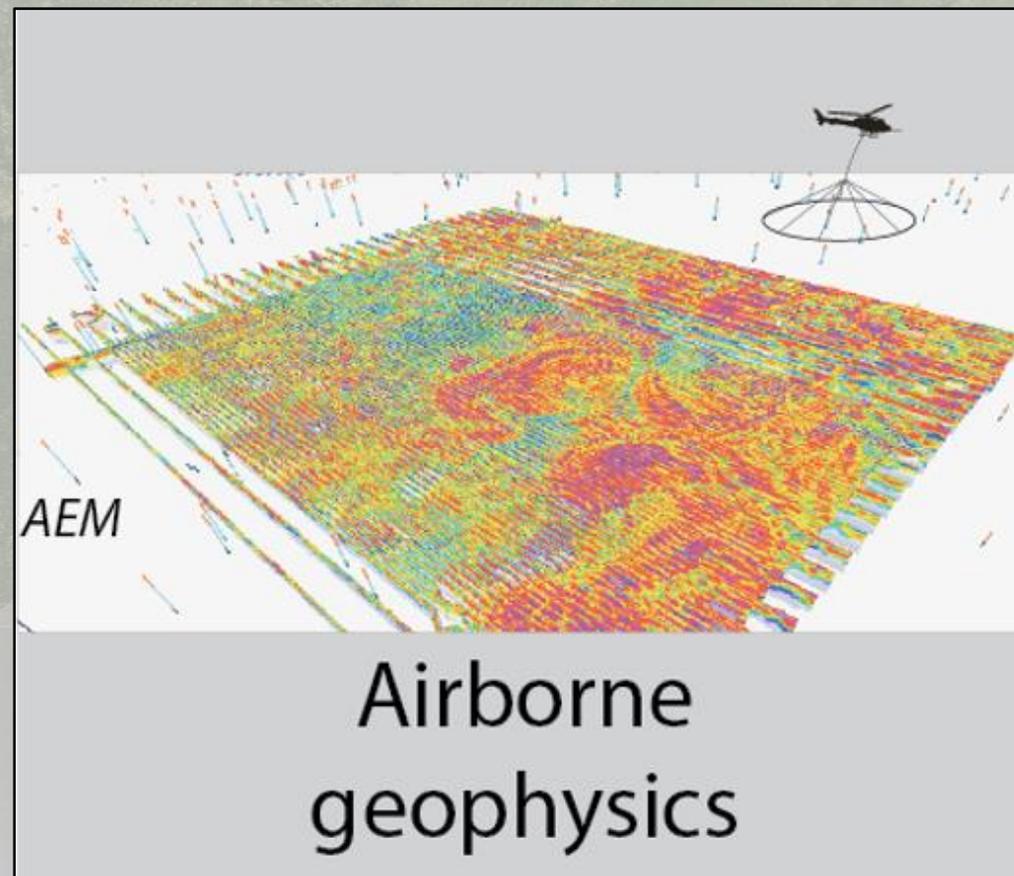


----- Provisional Data Subject to Revision -----

Hydrogeologic Framework Mapping Efforts



Geophysical Imaging

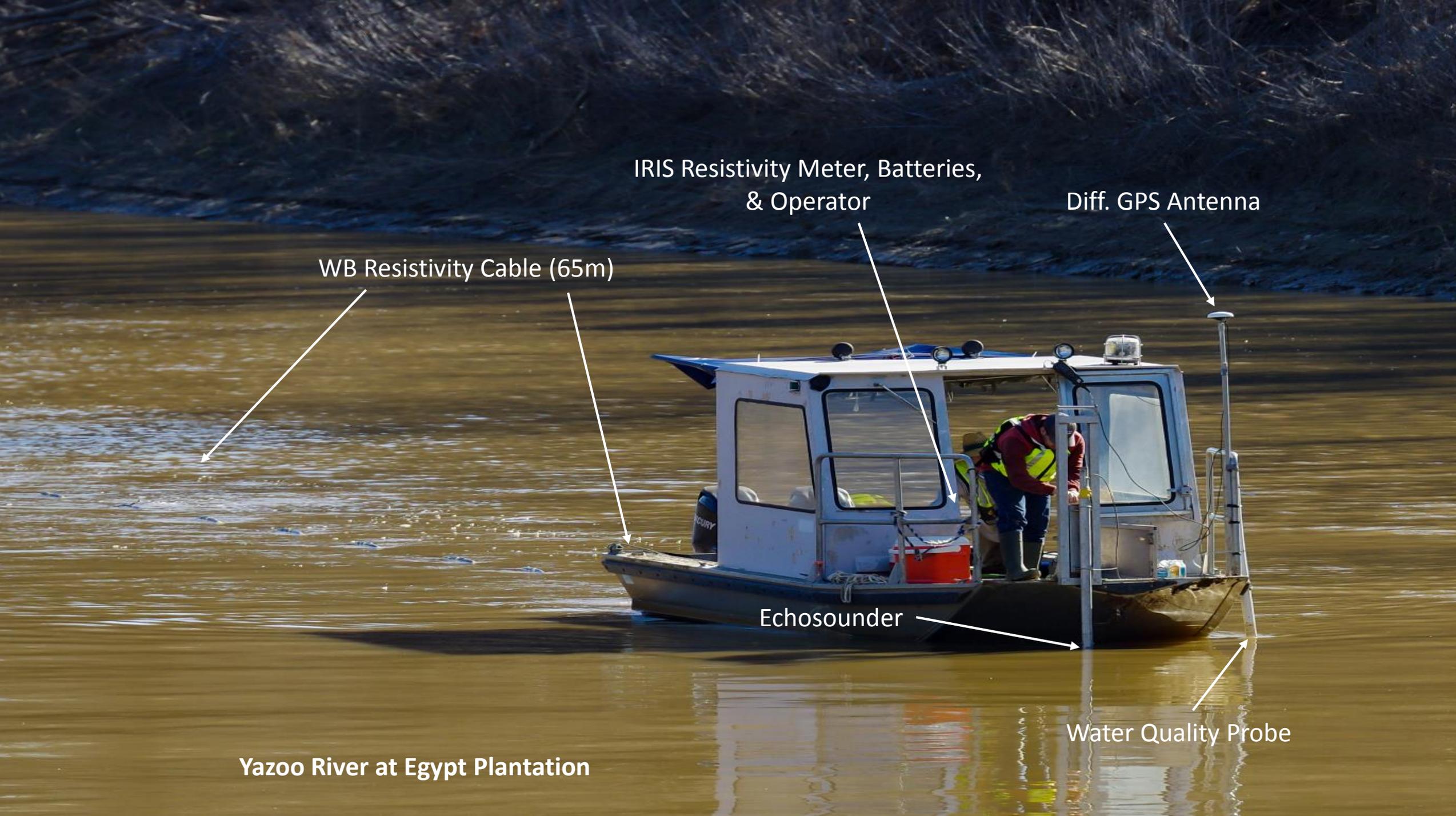


DGPS

Tx

Rx's





IRIS Resistivity Meter, Batteries,
& Operator

Diff. GPS Antenna

WB Resistivity Cable (65m)

Echosounder

Water Quality Probe

Yazoo River at Egypt Plantation

Waterborne Geophysics on the Ouachita River

- In October of 2018, USGS and Aarhus University staff surveyed 130 miles of the Ouachita River from Monroe to Jonesville
- As part of the USGS Mississippi Alluvial Plain (MAP) project, this survey investigated groundwater-surface water interaction along this reach of the Ouachita
- This technique identifies geologic properties of different sediment units based on their electrical properties down to a depth of 250 feet





**Resistivity
(ohm*m)**

Low

High



Sed. Size

Fine grained

Coarse grained

Sed. Type

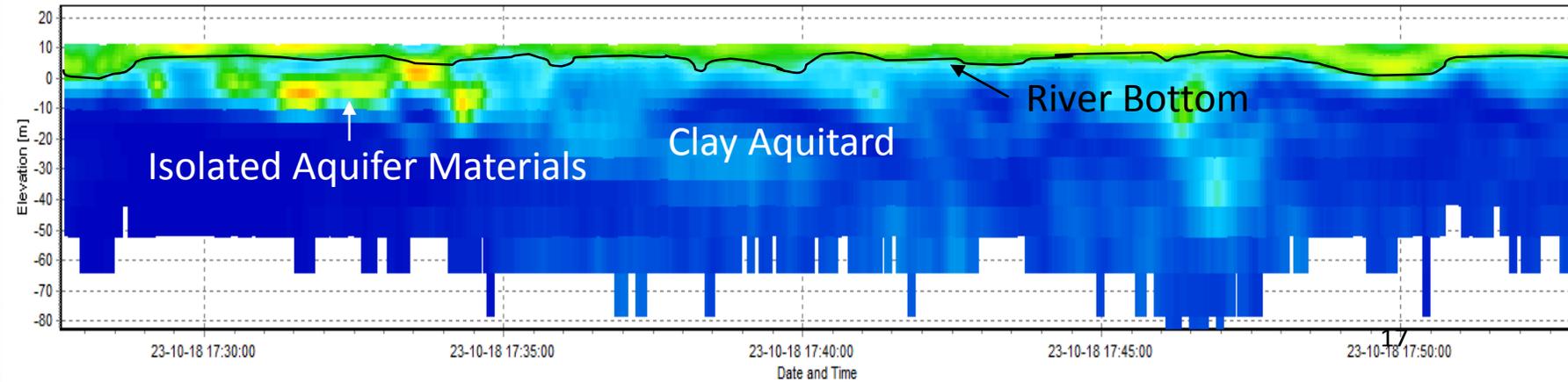
Clay

Sand

**SW/GW
Exchange
Potential**

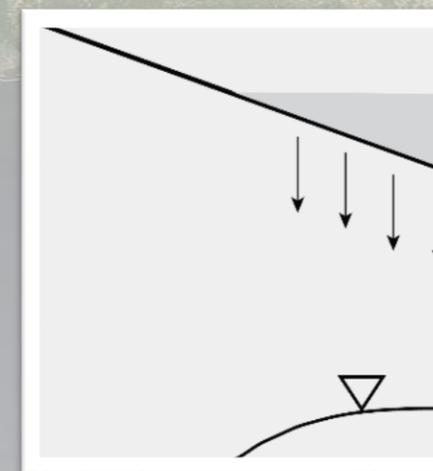
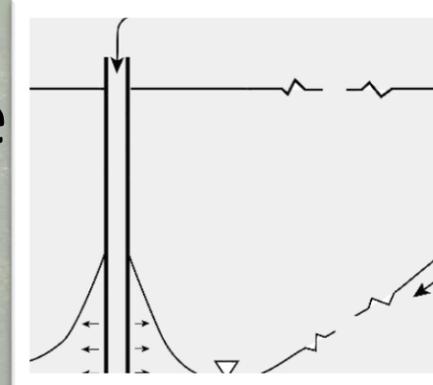
Lower Potential

Higher Potential



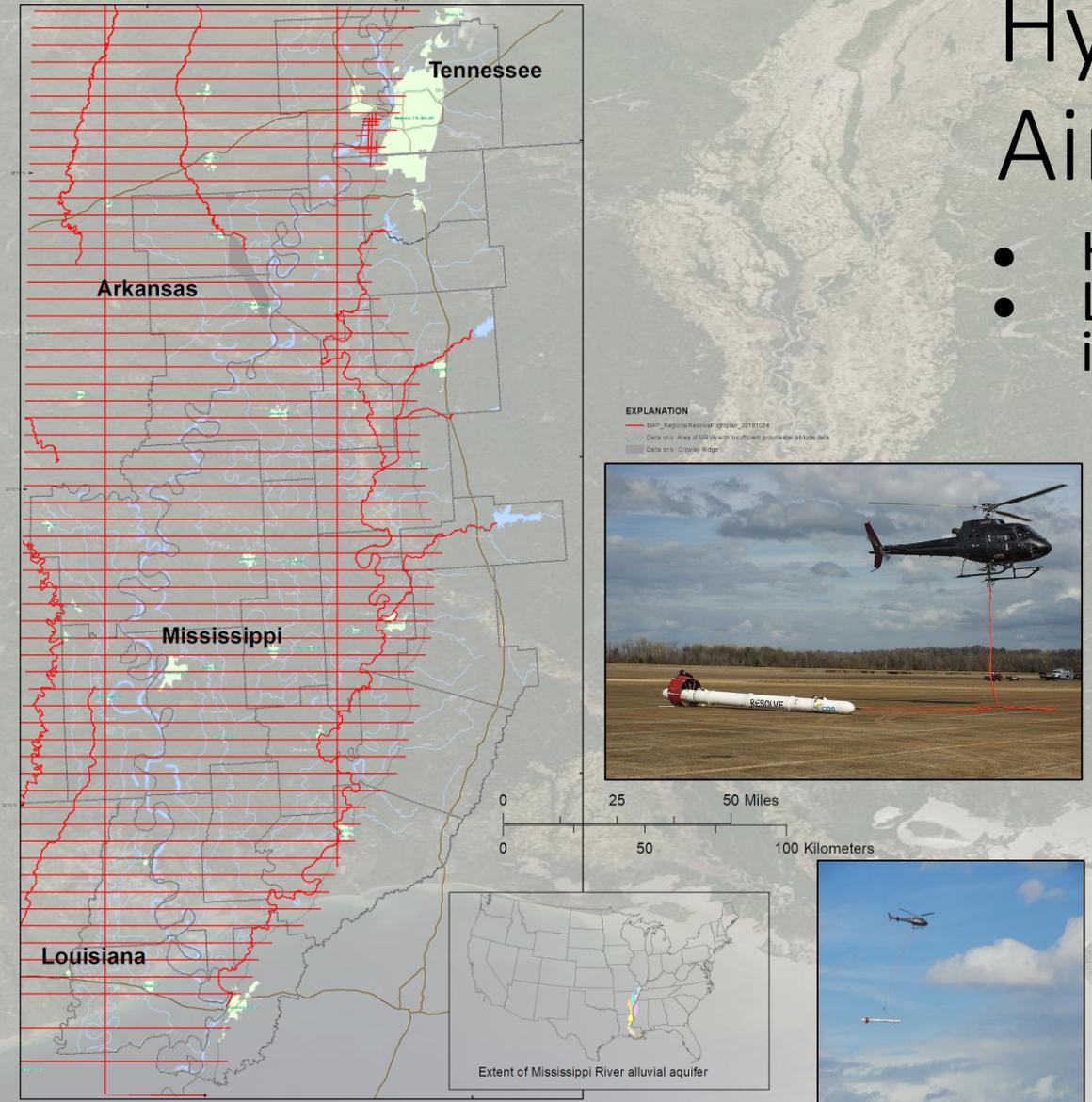
Geophysical Mapping

- Water resource management
 - Recharge
 - Groundwater/ Surface water exchange
 - Hydrogeologic framework
- Infrastructure projects
 - Groundwater transfer project
 - Enhanced recharge in rivers (weirs)
 - Mississippi River levee



Hydrogeologic Framework: Airborne Survey

- Helicopter and Fixed-wing platforms
- Largest AEM survey for water resource mapping in the CONUS



- Total planned +40,000 line-kms
 - Fall/Winter 2018: 19,000 line-km **(flying now)**
 - 12km line-spacing throughout entire region
 - 6km line-spacing for large continuous region in the middle
 - Summer 2019: 9,000 line-kms
 - More in 2020 and 2021

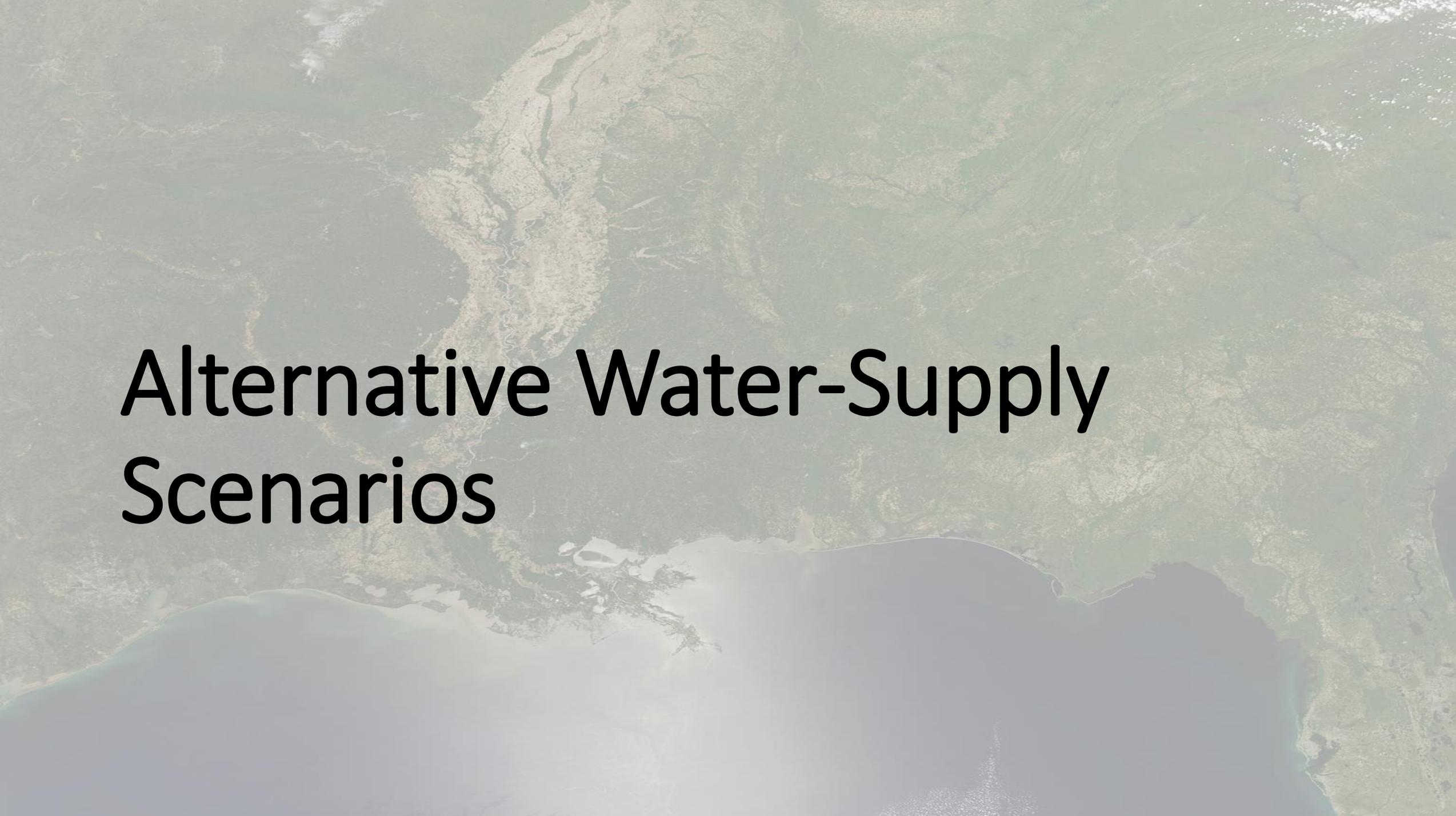
○ <http://arcg.is/01nraa>

Base from U.S. Geological Survey digital data, 1:1,000,000 and 1:2,000,000 variously dated
Highways from National Highway Planning Network, various scales, 2014
Urban areas from U.S. Census Bureau, 1:500,000, 2010
Albers_NAD projection
Standard parallel 42 30'N and 26 30'N, central meridian 90 00'W
World Geodetic Survey of 1984

Current extent of Mississippi River alluvial aquifer
(Painter and Westerman, 2018)
Regions in the Mississippi River Valley alluvial aquifer (Ladd and Travers, 2016)

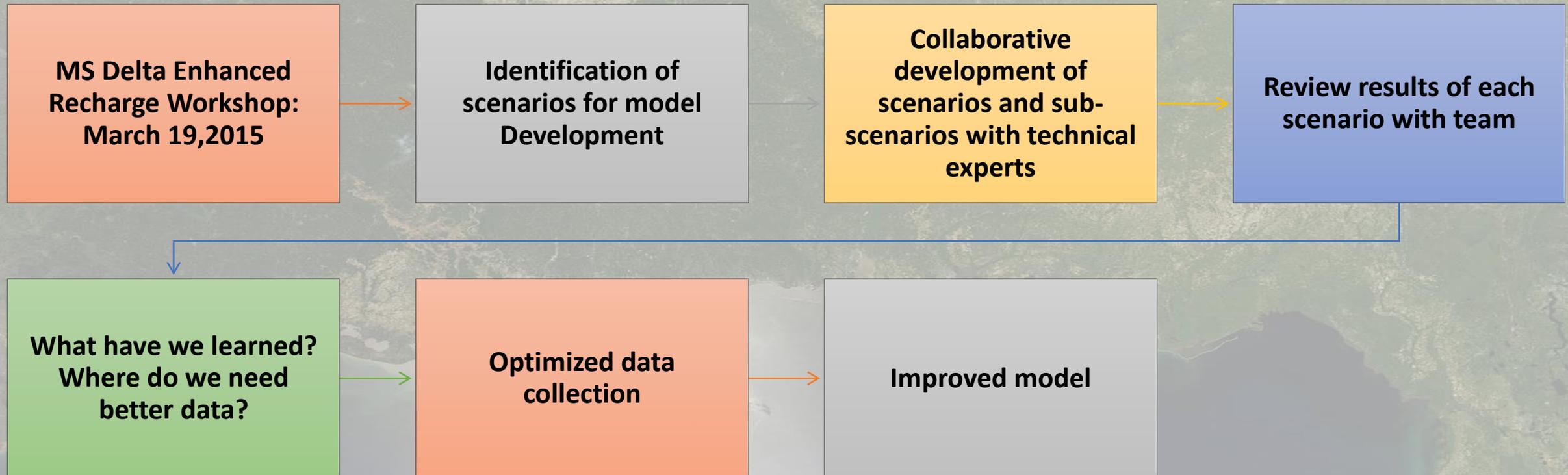


 **USGS**
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An aerial photograph of a coastal region, likely the San Francisco Bay Area, showing a large bay, surrounding land with green vegetation, and a prominent river or waterway. The image is semi-transparent, serving as a background for the text.

Alternative Water-Supply Scenarios

What can we model now? What information do we need for the future?



Modeling Purpose

The purpose of the model simulations are to:

1. Collect all relevant information about each alternative and identify the assumptions needed for the model
2. Assess the change in water-level relative to the base scenario resulting from each scenario
3. **Provide information related to the amount of water not pumped or injected AND the resulting water level response for an economic analysis of each scenario (MSU, Dr. Falconer)**
4. Identify areas in need of further research and data collection

Alternative Water-Supply Scenarios

Decrease GW Withdrawals

- Irrigation efficiency
- Instream weirs to increase surface-water availability
- Tailwater recovery and onsite farm storage
- Inter/intra-basin transfer(s)



Irrigation efficiency in the Mississippi Delta;
photo credit: Jason Krutz, MSU-DREC

Mundaring Water Treatment Plant, Australia;
photo credit: <http://www.water-technology.net>



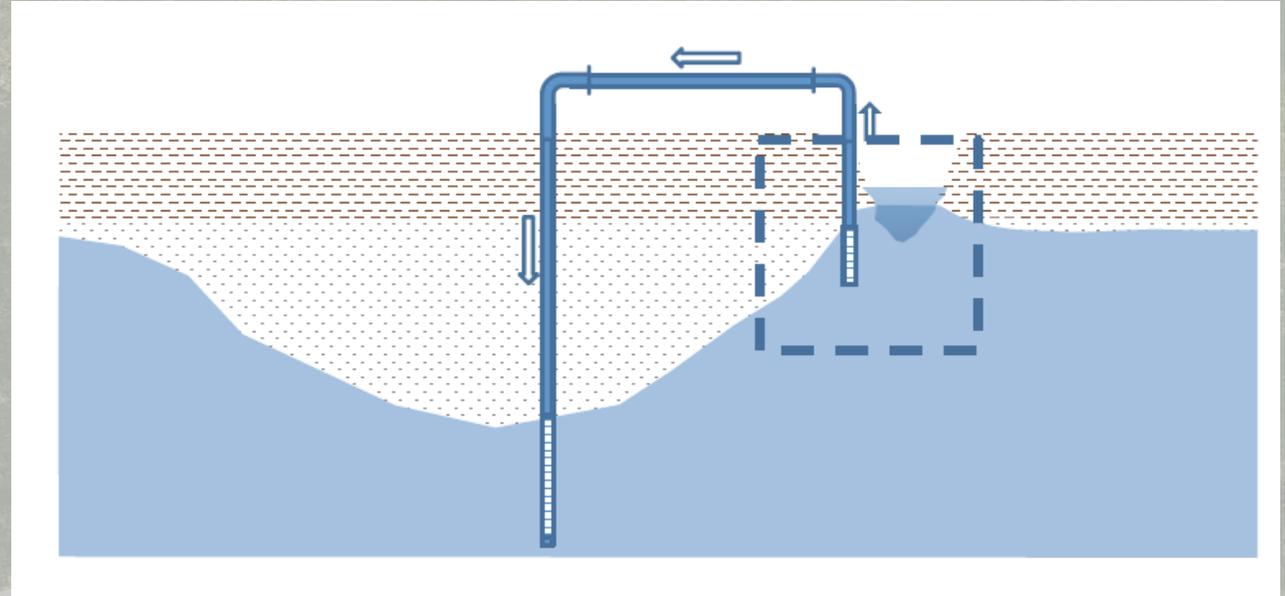
Alternative Water-Supply Scenarios

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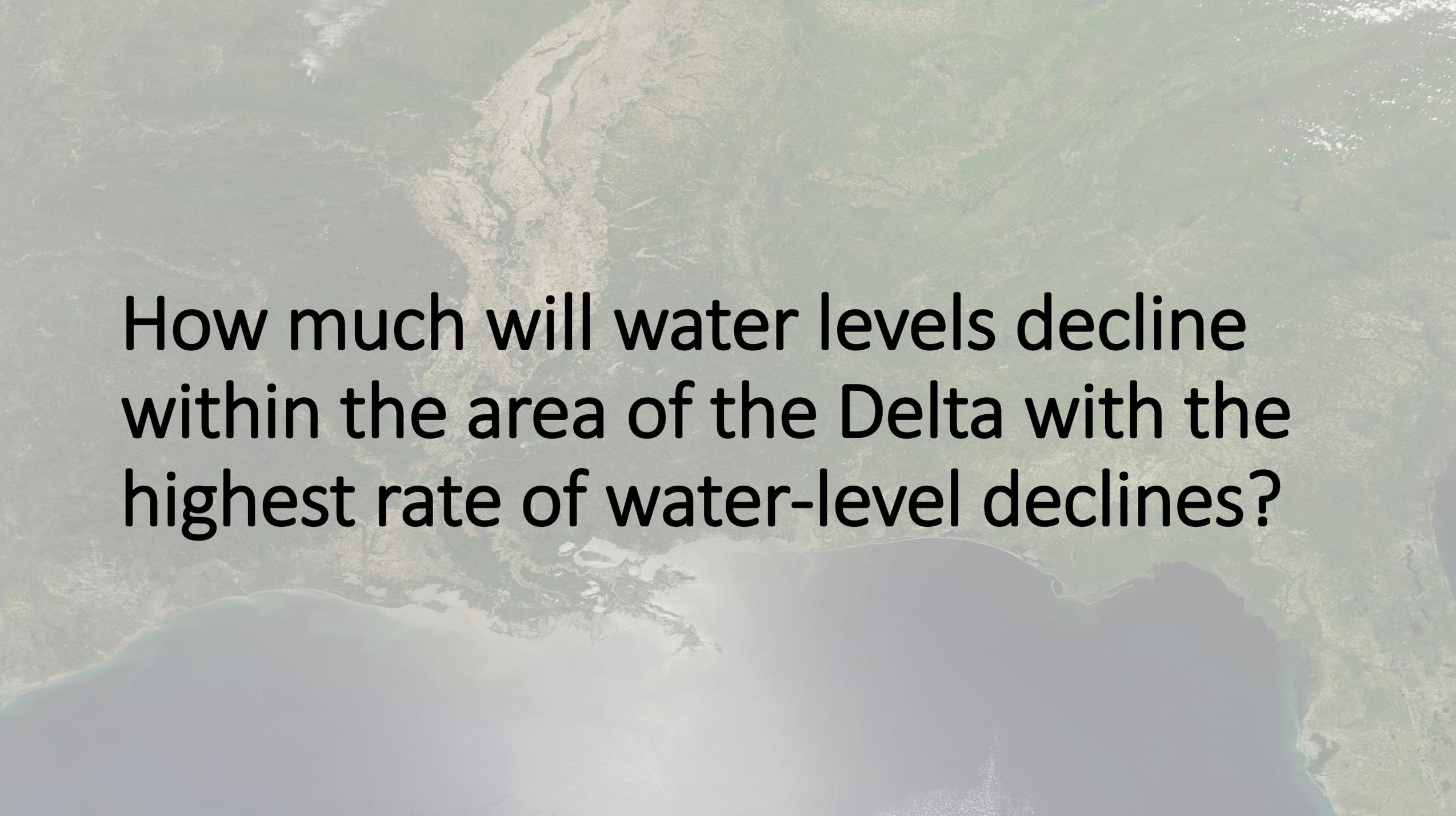
Increase Recharge to the Alluvial Aquifer

- Enhanced aquifer recharge



Groundwater transfer and injection schematic

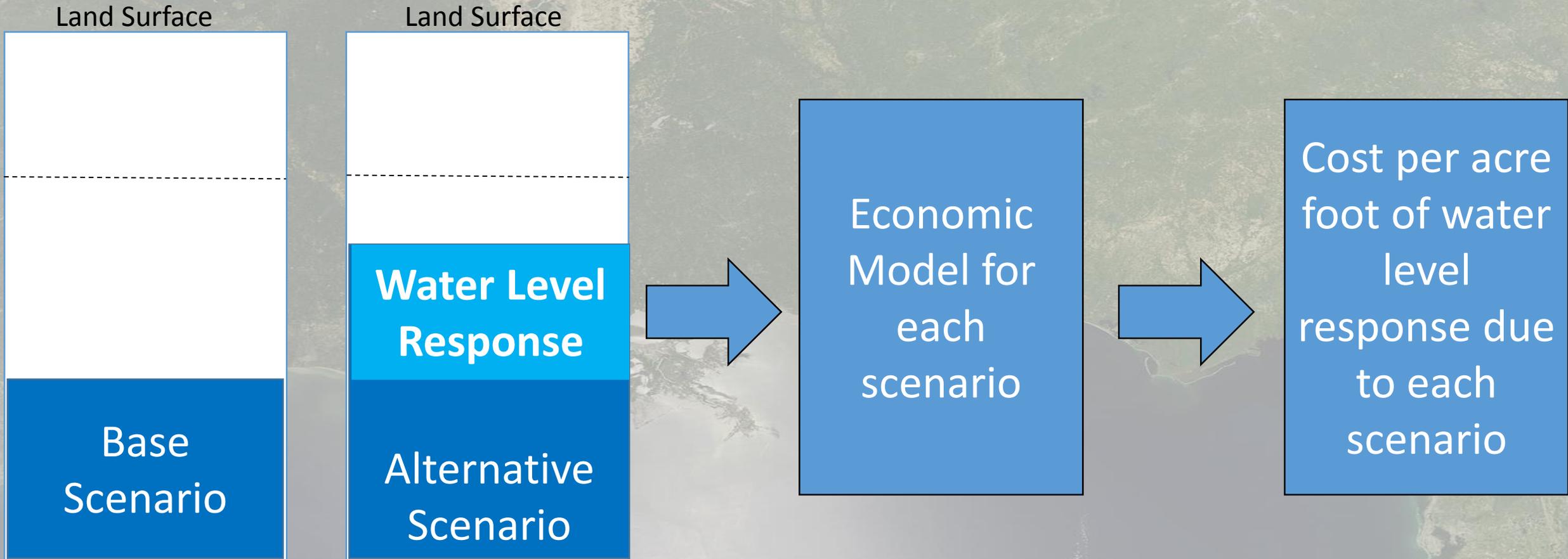
Image from Dr. J.R. Rigby, USDA-ARS

An aerial photograph of a river delta, showing a complex network of channels and distributaries. The land is a mix of green and brown, indicating vegetation and bare earth. The water is a dark blue-grey color. The text is overlaid on the center of the image, in a large, black, sans-serif font.

How much will water levels decline within the area of the Delta with the highest rate of water-level declines?

How much will it cost?

Connect water and economic models to estimate anticipated cost for each scenario.

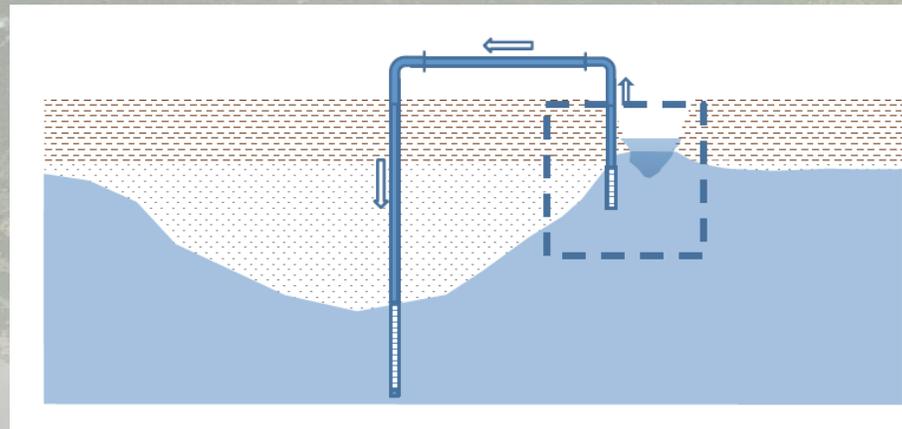


Economic Analysis: Most Realistic Scenarios

Scenario	Estimated Total NPV Cost of Project	Average Water Level Increase at Year 50 in Feet	Cost of Change - Average Foot of Increase
Irrigation Efficiency			
Delta Wide	\$354,913,325	15	\$23,660,888
Central Delta	\$9,295,469	10	\$929,547
In Stream Weirs 1/2 Mile Service Area			
66% Adoption Rate	\$6,724,753	8	\$840,594
33% Adoption Rate	\$11,560,932	4	\$2,890,233
Tallahatchie- Quiver 1/2 Mile Service Area			
66% Adoption Rate	\$51,427,291	4	\$12,856,823
33% Adoption Rate	\$49,113,657	2	\$24,556,829
Enhanced Aquifer Recharge			
10 Abstraction Wells	\$52,762,173	8	\$6,595,272
20 Abstraction Wells	\$105,524,338	17	\$6,207,314
30 Abstraction Wells	\$158,286,513	27	\$5,862,463
40 Abstraction Wells	\$211,048,680	35	\$6,029,962

Future efforts will involve
optimizing multiple
solutions

Goal: Provide reliable
scientific information to
MDEQ and The Task
Force in order to
maximize the resource,
minimize the costs



Questions?

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- **wkress@usgs.gov**

<http://www.usgs.gov/water/imp/man>